GIS Tutorial Series — II. Using GIS to Create DFIRMs

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In this tutorial, you will learn more about FEMA's use of Geographic Information Systems (GIS) to create Digital Flood Insurance Rate Maps (DFIRMs).

Topics covered include:

DFIRM components

Graphic, base map, and metadata specifications

Database design

Introduction

As GIS technology advances, it enhances FEMA's ability to reduce the loss to life and property by while providing protection from all hazards. GIS technology has proven useful to FEMA in various areas, including flood hazard mapping.

The first tutorial in this series provided you with an introduction to GIS technology. This tutorial will provide you with an overview of FEMA's use of GIS for the creation of Digital Flood Insurance Rate Maps (DFIRMs).

Introduction

Digital Flood Insurance Rate Maps (DFIRMs) are produced using digital methods, instead of the manual cartographic methods used to produce Flood Insurance Rate Maps (FIRMs).

Below are some of the advantages of using digital methods to produce DFIRMs:

Standard Technology

Easier Updates

Spatial Analysis

Data Management

Distribution Options

Different Viewing Scales

Ability to combine with other data

Sources (multi-hazard mapping)

Background: FIRM Product

Traditionally, older FIRMs product were distributed as paper maps and produced using manual cartographic methods. The maps were produced in five different paper sizes and were printed in blue and white tones.

Manual cartographic methods do not allow for easy spatial analysis. These methods are generally not cost effective for map revisions and updates.

Background: Modernizing DFIRMS

In order to modernize FEMA's mapping products, several workgroups were created to redesign the DFIRM product.

Learn about the workgroups by clicking on the topics listed below. An asterisk next the group's name indicates that the group's work is on hold pending finalization of graphic and database specifications.

List
DFIRM Issues and Workgroups

Graphic Specifications

Database Design

Metadata Specifications

Distribution Plan

User Applications

Use Policy

Implementation Strategy*

Cost Quantification*

Multi-Hazard Mapping*

Base Map Specifications

As part of FEMA's Map Modernization Plan, new base map specifications for DFIRMs were developed. Some key items in the new base map standards include accuracy, currency (less than 7 years), and ease of distribution (FEMA must be able to distribute the base maps).

For details on the base map specifications, go to
http://www.fema.gov/fhm/frm_bsmp.shtm

Additional information about the Map Modernization Plan is available at
http://www.fema.gov/fhm/mm_main.shtm

Base Map Specifications

A locally developed base map, typically a vector base map, may be used to produce the DFIRM, provided it meets FEMA's minimum base map standards.

If a locally developed base map is not available or does not meet FEMA's standards, a USGS Digital Orthophoto Quad (DOQ) will be used as the default base map (raster).

If complete coverage of neither is available, a combination of a raster and vector base map may also be used for the DFIRM. This combination option is called a "quilt" map.

Base Map Data

Base map data includes roads, railroads, hydrography (e.g., streams), and community boundaries.

The base map may be in vector format, as shown here. (Map example graphic.)

Base Map Data (continued)

The base map may also be in raster format as shown in this example (base map graphic). Raster base maps will also require some vector information such as community boundaries along with annotated layers for items such as street names.

Flood Hazard Data

DFIRMs also include flood hazard data. This data normally contains base flood elevations (BFEs), cross sections, and zone designations with boundaries and floodway locations.

The Compilation Process: Introduction

The ease with which FEMA will be able to combine the two main data components often depends on the format and map projection of the data received.

FEMA may receive data in a variety of GIS or CADD formats and map projections. Technicians must then put the data in a standard map projection and a standard GIS format for use in FEMA's GIS.

For more information on map projections, see the first tutorial in this series: *Introduction to GIS*.

(Image Caption) To conform to FEMA standards, data must be in a standard map projection.

The Compilation Process: Introduction (continued)

FEMA must standardize the data in order to produce DFIRMs. This process is known as map compilation. The first step in the process is to review the data received to ensure it is complete. The second step is to put the base map and flood hazard data into a standard GIS format, map projection, and coordinate system.

The Compilation Process: Data Format

FEMA receives data in a variety of formats, depending on the software packages being used by a community or contractor. The GIS software companies listed here are examples of the file formats are received by FEMA for the creation of DFIRMs.

Selection of GIS Software Companies

- **ESRI (ArcView, Arc/INFO)**
- **MapInfo (MapInfo)**
- **Caliper (Maptitude)**
- **Intergraph (GeoMedia)**
- **Tactician (Tactician)**

*__Note__: This is not a comprehensive list of the types of GIS software packages available and does not constitute FEMA's endorsement of these companies and their products.

The Compilation Process: Map Projection and Coordinate System

The data must also be transferred into a common projection. The base map data and SFHA data must be in the same map projection and coordinate system in order to match up with each other.

These examples show the importance of using the appropriate projection and coordinate system.

Finalizing the map

Once the data has gone through the compilation process, the maps are annotated with text, symbols are selected and assigned for specific features, and the final look of the map is developed.

Please note that the colors shown on the image to the right are used during production but are not the colors used for the final DFIRM.

Finalizing the map (continued)

Cartographers use a special GIS application to create the DFIRMs. This results in faster production times and easier updates than traditional cartographic methods.

The image on the right is a sample of the functions available to the cartographers.

Finalizing the map (continued)

The example shown on the right depicts a custom application built using ESRI's ArcInfo software.* It automates many of the cartographic steps such as labeling and symbology.

This custom application was developed to incorporate FEMA's DFIRM graphic specifications.

*__Note__: This is not a comprehensive list of the types of GIS software packages available and does not constitute FEMA's endorsement of these companies and their products.

Quality Control Phase

In the quality control phase, another automated GIS application is used. The Quality Control phase may involve checking the hardcopy FIRM. This application takes advantage of the data behind the map to create special maps for on-screen review.

For example, SFHAs are colored in different shades to check for labeling errors in the image to the right. This allows QC staff to check for topology and attribute errors quickly and easily.

DFIRM Database

The Standard DFIRM Spatial Database contains information from the engineering models along with information about the map features. This allows users to perform automatic analyses using GIS that were nearly impossible to perform with hardcopy FIRMs.

For more information on the DFIRM Spatial Database, go to http://www.fema.gov/fhm/dfm_dfdb.shtm

Summary

This tutorial has provided you with an overview of the use of GIS technology in the creation of FEMA's DFIRM product, as well as an overview of the final product's features, including:

Base map

Flood hazard information

Finished cartographic product with labels and symbology

Database with supporting information